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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
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| 09/459,305 | 12/10/1999 | TOMOYUKI FURUHATA | 0015.0010 | 9991 |

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KONRAD RAYNES VICTOR & MANN, LLP
315 SOUTH BEVERLY DRIVE
SUITE 210
BEVERLY HILLS, CA 90212

EXAMINER

TRAN, THIEN F

| | |
|----------|--------------|
| ART UNIT | PAPER NUMBER |
|----------|--------------|

2811

DATE MAILED: 09/24/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/459,305

Applicant(s)

FURUHATA, TOMOYUKI

Examiner

Thien Tran

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-- *Th MAILING DATE of this communication appears on the cover sheet with the correspondence address --*

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 30 June 2003.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 13, 15-19, 30 and 32-54 is/are pending in the application.
- 4a) Of the above claim(s) 15 and 17-19 is/are withdrawn from consideration.
- 5) ☒ Claim(s) 13, 16, 30, 32-34, 44-47 and 52-54 is/are allowed.
- 6) ☒ Claim(s) 35, 36, 38-43 and 48-51 is/are rejected.
- 7) ☒ Claim(s) 37 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

Claim Objections

Claim 13 is objected to because of the following informalities: line 9, "being capable of" should be deleted. Appropriate correction is required.

Claim 16 is objected to because of the following informalities: line 2, "the impurity concentration of the connecting area" should be --an impurity concentration of the connecting area--; lines 2-3, "the impurity concentrations of all the sources and drains" should be --impurity concentrations of all the sources and drains--. Appropriate correction is required.

Claim 30 is objected to because of the following informalities: line 17, "capable of" should be deleted. Appropriate correction is required.

Claim 33 is objected to because of the following informalities: line 13, "capable of" should be deleted; line 16, "the impurity concentration of the connecting area" should be --an impurity concentration of the connecting area--; line 17, "the impurity concentrations of the first source/drain regions" should be --impurity concentrations of the first source/drain regions--; lines 17-18, "the impurity concentrations of the second source/drain regions" should be --impurity concentrations of the second source/drain regions--. Appropriate correction is required.

Claim 40 is objected to because of the following informalities: line 3, "the trench" should be --the groove--. Appropriate correction is required.

Claim 44 is objected to because of the following informalities: line 9, "being capable of" should be deleted. Appropriate correction is required.

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Claim 48 is objected to because of the following informalities: line 17, "capable of" should be deleted. Appropriate correction is required.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claims 35, 36, 38-43, 48-51 are rejected under 35 U.S.C. 102(e) as being anticipated by Hirayama (USPN 6,015,725 of record).

Hirayama discloses the claimed semiconductor device (Fig. 6) comprising a semiconductor substrate 2 including first and second memory cell areas; the first memory cell area including a first field effect transistor comprising a first gate insulating film 6 in contact with the semiconductor substrate, a first floating gate 32 in contact with the first gate insulating film, a first dielectric layer 33 in contact with the first floating gate, a first control gate 34 in contact with the first dielectric layer, and first sources/drain regions (3, 4b, b) extending into the semiconductor substrate; the second memory cell area including a second field effect transistor comprising a second gate insulating film 6 in contact with the semiconductor substrate, a second floating gate 32 in contact with the second gate insulating film, a second dielectric layer 33 in contact with the second floating gate, a second control gate 34 in contact with the second

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dielectric layer, and second sources/drain regions (3, 4b, 5) extending into the semiconductor substrate; the first source/drain regions and the second source/drain regions each including an upper surface that extends along a common plane; a groove 14 located in the semiconductor substrate at a position between the first and second memory cell areas; an impurity area 4a electrically connecting the first source of first cell area with the second source of the second cell area, wherein the impurity area 4a with high doping concentration inherently has an electric resistance which is lower than that of the first source/drain regions and lower than that of the second source/drain regions, wherein the impurity area 4a extends under the groove in the semiconductor substrate, wherein the impurity area also includes first and second end regions that extend adjacent to sides of the grooves; and wherein the first end region is in contact with the first gate insulating film and the second end region is in contact with the second gate insulating film. Hirayama does not explicitly disclose the first and second gate insulating films 6 being a tunnel insulating films. However, in EPROM device, gate insulating films perform the function as tunnel insulating films wherein electrons from the channel region are injected (tunneling) through the films into the floating gate so charge can be stored in the floating gate during the write operation. Therefore, it is inherent that the gate insulating films 6 are tunnel insulating films.

Regarding claims 41, 42, 50 and 51, the groove 14 comprises an etched groove having sidewalls and a lower surface, wherein the sidewalls are orthogonal to the lower surface.

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Regarding claims 35, 36 and 39, Hirayama discloses first and second memory cells having first and second field effect transistors for storing data, the first and second memory cells including source/drain regions formed in a semiconductor substrate 2; groove 14 extending into the semiconductor substrate at a position between the first and second field effect transistors; and a conducting region 4a connecting a source/drain (3, 4b) of the first field effect transistor to a source/drain (3, 4b) of the second field effect transistor, the conducting region being positioned below the groove and the conducting region having a lower resistance than the source/drain region (3, 4b).

Regarding claim 38, an insulating material 6 is in contact with the semiconductor substrate in the groove.

Regarding claims 40 and 49, an interlayer dielectric layer 8 is on the first and second field effect transistors, the interlayer dielectric layer extends into the groove.

Regarding claim 43, an insulating film 6 is above the source/drain regions, wherein a portion of ends of the conducting region 4a is in direct contact with the insulating film.

Allowable Subject Matter

Claims 13,16, 30, 32-34, 44-47, 52-54 are allowed.

Claim 37 is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Conclusion

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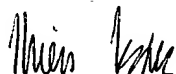
Any inquiry concerning this communication or earlier communications from the examiner should be directed to Thien Tran whose telephone number is (703) 308-4108. The examiner can normally be reached on 8:30AM - 5:00PM Monday through Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tom Thomas can be reached on (703) 308-2772. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

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September 10, 2003



Thien Tran
Patent Examiner
Technology Center 2800